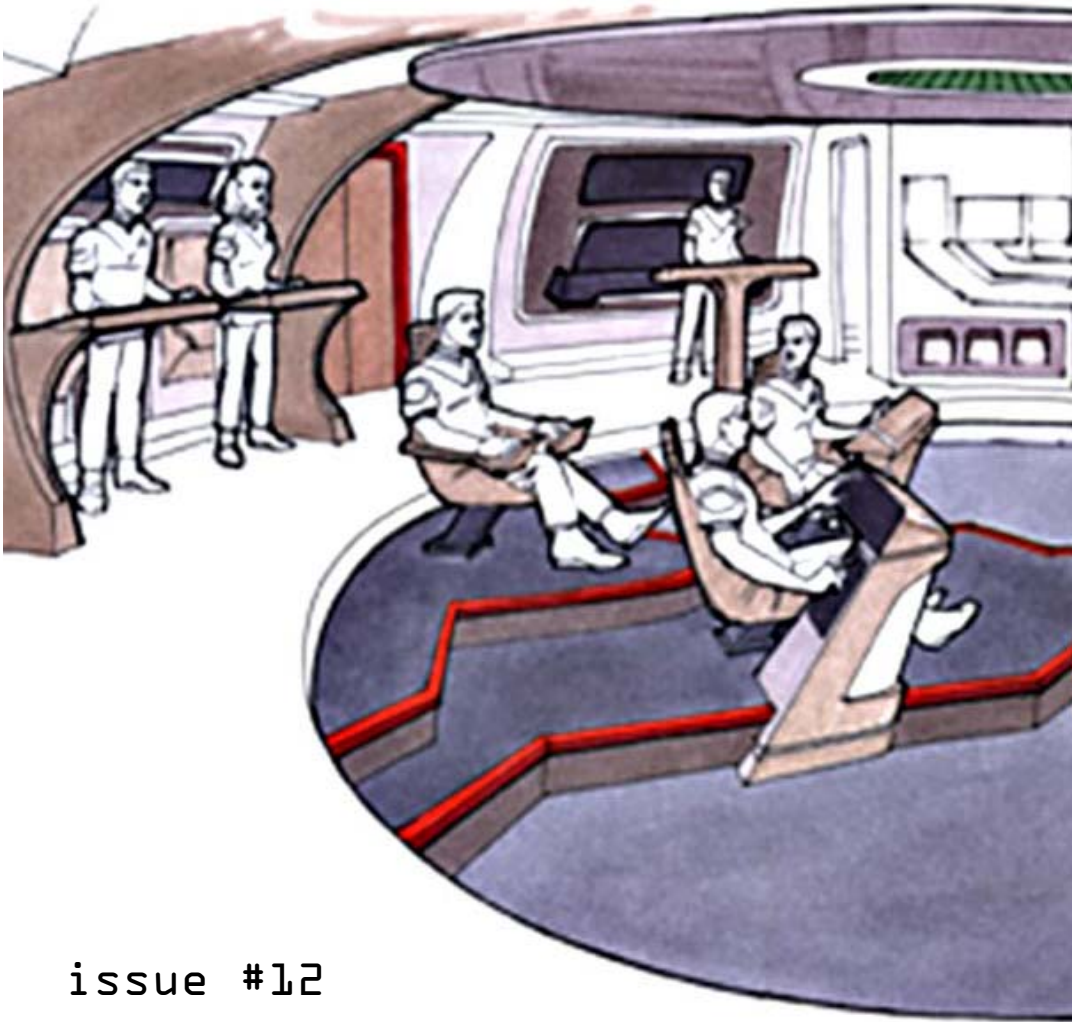


nerdling



issue #12

introduction

Earlier this year, one scientific research project brought us the knowledge that drinking green tea turns mice into better swimmers, and another provided the technology to supply George W. Bush with a \$127 billion robot army. Cambridge University scientists were found to have tortured their laboratory monkeys, nuclear scientists in Nevada were practising ‘science by peer pressure’ and covering up their findings, and IMAX theatres in the US south were deciding not to screen educational films about volcanoes because they might offend Christians.

These examples, of which there are many more on page 24, show science doing what it does naturally: interacting with the wonderful, grotty, complicated world of society, politics, superstition, love and war.

As scientists and engineers it can be easy to forget these things, especially after we’ve spent several years becoming specialists in gecko chemistry or military cybernetics. We may forget the reason for our research.

We may also forget that outside of the lab the technical brilliance of a project doesn’t guarantee its success. Recently an international project to install solar cells in remote South American communities failed because, after installation, it was discovered that certain communities worshipped sun gods and considered it blasphemous to exploit energy from the sun. The technology had been engineered brilliantly—but no-one thought to ask the people what they wanted.

Unfortunately, similar examples exist in Australia and other western countries. Sometimes the public rejects a particular technology: nuclear power, for example, or recycled waste water for drinking in drought-affected regions. Sometimes the rejection is a result of misunderstanding the technology—but sometimes it’s because they are judging it by different values, which aren’t necessarily wrong because they are non-technical. A certain science commentator at my university reacts to cases like this by calling the public “ignorant hippies”.

He is wrong. If the public don’t understand a particular technology, it’s our problem, not theirs. We obviously haven’t done a good enough job of

explaining it. If we do explain it well and they reject it nonetheless, sometimes we have to accept that decision

In case this sounds too much like ‘hippy talk’, let me quote the opinion of Quantum Mechanics God Erwin Schrödinger himself:

“[A scientist should] see the limits of his subject matter. In his teaching [he should] make the students aware of these limits, and show them that beyond these limits forces come into play which are no longer entirely rational, but arise out of life and human society itself.”

[Quoted by S. from the report of the Commission for University Reform in Germany.] As to the personal obligation of the scientist, Schrödinger says,

“Never lose sight of the role your particular subject has within the great performance of the tragi-comedy of human life; keep in touch with life ... and Keep life in touch with you. If you cannot—in the long run—tell everyone what you have been doing, your doing has been worthless.”

In other words, there is more to life than science, and it’s everyone’s job to keep the big picture in mind.

Of course this doesn’t mean I believe the public’s opinion can never be harmfully irrational or just plain wrong. I do, however, think that scientists always have to remember that they and their research and technology are part of the ‘great performance of the tragi-comedy of human life’ — and that it never hurts to listen to others.

—the editor

nerdling.zine@gmail.com

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Some of the greatest scientists started out mucking around in backyard laboratories when they were kids. Read about some of the explosions, injuries and anti-matter-creation that resulted.

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Does eating carrots turn you orange? What happens if you microwave a pepper shaker? These crazy idiots decided to find out for themselves. We hail them.

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You won't understand it until you make it.

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Maths is the universal language to bring together all nations in peace and harmony, right?

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p 24: Glorious Progress Through Science: 2005

Science is a tool of humanity. Decide for yourself how we're using that tool.

HOME SCIENCE

Hyperspace guru Michio Kaku built his own atom-smasher when he was a teenager that regularly blew all the fuses in his mum's house. Nobel prize-winning physicist Richard Feynman once peed upside down in an experiment to settle a scientific question with his friends. Oliver Sacks regularly hurled flaming reagents out of his backyard lab onto the lawn. Many famous and respected scientists have started their careers as kids in makeshift home laboratories. Not all experiments were successful. The extracts below tell some of their stories.

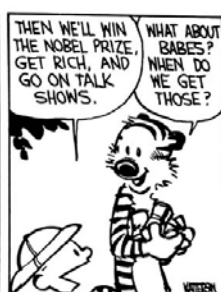
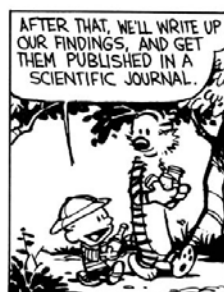
MICHIO KAKU, physicist and author
—from his book *Hyperspace*

One advantage of youth is that it is undaunted by worldly constraints that would ordinarily seem insurmountable to most adults. Not appreciating the obstacles involved, I set out to build my own atom smasher. I studied the scientific literature until I was convinced that I could build what was called a betatron, which could boost electrons to millions of electron volts. (A million electron volts is the energy attained by electrons accelerated by a field of a million volts.)

First, I purchased a small quantity of sodium-22, which is radioactive and naturally emits positrons (the antimatter counterpart of electrons). Then I built what is called a cloud chamber, which makes visible the tracks left

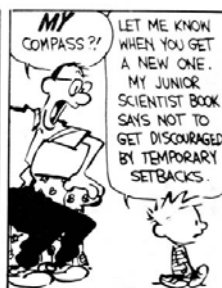
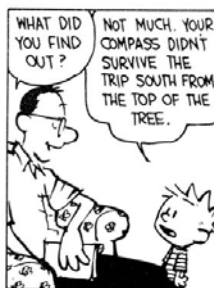
by subatomic particles. I was able to take hundreds of beautiful photographs of the tracks left behind by antimatter. Next I scavenged around large electronic warehouses in the area, assembled the necessary hardware, including hundreds of pounds of scrap transformer steel, and built a 2.3-million-electron-volt betatron in my garage that would be powerful enough to produce a beam of antielectrons. To construct the monstrous magnets necessary for the betatron, I convinced my parents to help me wind 22 miles of copper wire on the high-school football field. We spent Christmas vacation on the 50-yard line, winding and assembling the massive coils that would bend the paths of the high-energy electrons.

When finally constructed, the 300-pound, 6-





YOU KNOW HOW MAPS ALWAYS SHOW NORTH AS UP AND SOUTH AS DOWN? I WANTED TO SEE IF THAT WAS TRUE OR NOT.



kilowatt betatron consumed every ounce of energy my house produced. When I turned it on, I would usually blow every fuse, and the house would suddenly become dark. With the house plunged periodically into darkness, my mother would often shake her head. (I imagined that she probably wondered why she couldn't have a child who played baseball or basketball, instead of building these huge electrical machines in the garage.) I was gratified that the machine successfully produced a magnetic field 20,000 times more powerful than the earth's magnetic field, which is necessary to accelerate a beam of electrons.

RICHARD FEYNMAN, Nobel physicist

—From his book *Surely You're Joking, Mr Feynman!*

When I was about eleven or twelve I set up a lab in my house. It consisted of an old wooden packing box that I put shelves in. I had a heater, and I'd put in fat and cook french-fried potatoes all the time. I also had a storage battery, and a lamp bank. [...]

I had a Ford coil -- a spark coil from an automobile -- and I had the spark terminals at the top of my switchboard. I would put a Raytheon RH tube, which had argon gas in it, across the terminals, and the spark would make a purple glow inside the vacuum -- it was just great!

One day I was playing with the Ford coil, punching holes in paper with the sparks, and the paper caught on fire. Soon I couldn't hold it any more because it was burning near my fingers, so I dropped it in a metal wastebasket which had a lot of newspapers in it. Newspapers burn fast, you know, and the flame looked pretty big inside the room. I shut the door so my mother -- who was playing bridge with some friends in the living room -- wouldn't find out there was a fire in my room, took a magazine that was lying nearby, and put it over the wastebasket to smother the fire.

After the fire was out I took the magazine off, but now the room began to fill up with smoke. The wastebasket was still too hot to handle, so I got a pair of pliers, carried it across the room, and held it out the window for the smoke to blow out.

But because it was breezy outside, the wind lit the fire again, and now the magazine was out of reach. So I pulled the flaming wastebasket back in through the window to get the magazine, and I noticed there were curtains in the window -- it was very dangerous!

Well, I got the magazine, put the fire out again, and this time kept the magazine with me while I shook the glowing coals out of the wastepaper basket onto the street, two or three floors below. Then I went out of my room, closed the door behind me, and said to my mother, "I'm going out to play," and the



smoke went out slowly through the windows.

I also did some things with electric motors and built an amplifier for a photo cell that I bought that could make a bell ring when I put my hand in front of the cell. I didn't get to do as much as I wanted to, because my mother kept putting me out all the time, to play. But I was often in the house, fiddling with my lab.

I met an old friend of mind on the beach at our home town of Far Rockaway, where we grew up together. We had gone to school together when we were about eleven or twelve, and were very good friends. We were both scientifically minded. He had a "laboratory", and I had a "laboratory." We often played together, and discussed things together.

We used to put on magic shows - chemistry magic - for the kids on the block. My friend was a pretty good showman, and I kind of liked that too. We did our tricks on a little table, with Bunsen burners at each end going all the time. On the burners we had watch glass plates (flat glass discs) with iodine on them, which made a beautiful purple vapor that went up on each side of the table while the show went on. It was great! We did a lot of tricks, such as turning "wine" into water, and other chemical color changes. For our

finale, we did a trick that used something which we had discovered. I would put my hands (secretly) first into a sink of water, and then into benzine. Then I would "accidentally" brush by one of the Bunsen burners, and one hand would light up. I'd clap my hands, and both hands would then be burning. (It doesn't hurt because it burns fast and the water keeps it cool.) Then I'd wave my hands, running around yelling, "FIRE! FIRE!" and everyone would get all excited. They'd run out of the room, and that was the end of the show!

Later on I told this story at college to my fraternity brothers and they said, "Nonsense! You can't *do* that!"

(I often had this problem of demonstrating to these fellas something that they didn't believe - like the time we got into an argument as to whether urine just ran out of you by gravity, and I had to demonstrate that that wasn't the case by showing them that you can pee standing on your head. Or the time when somebody claimed that if you took aspirin and Coca-Cola you'd fall over in a dead faint directly. I told them I thought it was a lot of baloney, and offered to take aspirin and Coca-Cola together. Then they got into an argument whether you should have the aspirin before the Coke, just after the Coke, or mixed in the Coke. So I had six aspirin and three Cokes, one right after the other. First, I

took two aspirins and then a Coke, then I took a Coke and two aspirins. Each time the idiots who believed it were standing around me, waiting to catch me when I fainted. But nothing happened. I do remember that I didn't sleep very well that night, so I got up and did a lot of figuring, and worked out some of the formulas for what is called the Riemann-Zeta function.)

"All right, guys," I said. "Let's go out and get some benzene."

They got the benzene ready, I stuck my hand in the water in the sink and then into the benzene and lit it...and it hurt like hell! You see, in the meantime I had grown *hairs* on the back of my hand, which acted like wicks and held the benzene in place while it burned, whereas when I had done it earlier I had no hairs on the back of my hand. After I *did* the experiment for my fraternity brothers, I didn't have any hairs on the back of my hands either.

(Full text available at gorgorot.com)

OLIVER SACKS, Neurologist, author of *The Man Who Mistook His Wife For A Hat*, and portrayed by Robyn Williams in the movie *Awakenings*.

—Extract from his autobiography *Uncle Tungsten*

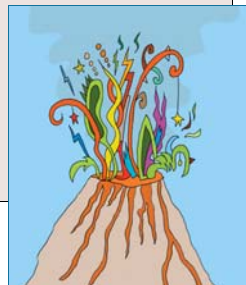
My parents and my brothers had introduced me, even before the war, to some kitchen chemistry: pouring vinegar on a piece of chalk in a tumbler and watching it fizz, then pouring the heavy gas this produced, like an invisible cataract, over a candle flame, putting it out straightaway. Or taking red cabbage, pickled with vinegar, and adding household ammonia to neutralize it. This would lead to an amazing transformation, the juice going through all sorts of colours, from red to various shades of purple, to turquoise and blue, and finally to green. [...]

And so I set up a little lab of my own at home. There was an unused back room I took over, originally a laundry room, which had running water and a sink and drain and various cupboards and shelves. Conveniently, this room led out to the garden, so that if I concocted something that caught fire, or boiled over, or emitted noxious fumes, I could rush outside with it and fling it on the lawn. The lawn soon developed charred and discoloured patches, but this, my parents felt, was a small price to pay for my safety—their own, too, perhaps. But seeing occasional flaming globules rushing through the air, and the general turbulence and abandon with which I did things, they were alarmed, and urged me to plan experiments and to be prepared to deal with fires and explosions.

Kitchen Vulcanology Experiments

Lava researchers Soule and Cashman recently published a paper in the journal *Geology* in which they used kitchen items to model volcanic lava flow.

The researchers used corn syrup to model hot basaltic magma, and mixed it with rice to represent the lava crystals. They found that by adding progressively more and more rice (to increase the viscosity of the 'lava') the flow behaved just like real lava, transforming from the relatively smooth *Pahoehoe* flow to the jumbled, sharp, angular *a'a* flow.



Calvin & Hobbes
Cartoons are by Bill
Watterson

THE^{amateur} HOME SCIENCE

Scientifically rigorous? Nope. More fun than reading a textbook? Hell yes. Amateur Do-It-Yourself

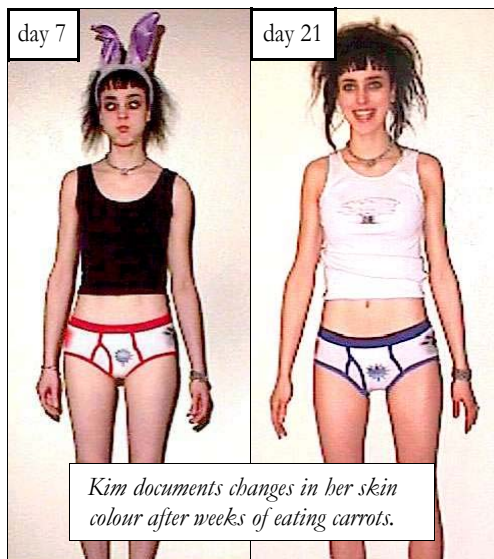
THE CAROTENE EXPERIMENT

www.steelgirl.com/carrot.htm

"Can your skin turn orange if you eat too many carrots? We plan to answer that question as I go on a carrot diet for thirty days."

Kim ate 227 carrots and drank 124 glasses of carrot juice in a month and recorded her experience in a weblog. She made and ate carrot soup, carrot cake, carrot ice-cream, carrots dipped in icing, carrot pizza, candied carrots with tofu and more. Along the way she did a lot of research into carrots, collected many carrot recipes, and conducted a poll to see if people wanted her to post a photo of her orange poo (the 'no' vote won). Readers emailed personal stories of carrot-induced orange-skin incidents, her mum sent her concerned messages about eating a balanced diet, and people were generally divided between thinking she was totally nuts ("beta-carotene poisoning... You CAN die from it") and thinking she was a hero ("You had an idea and pursued it. Good for you. It's a model for young people everywhere.") Appropriately, to celebrate the finish of her experiment she died her hair green.

Her conclusion: her fingernails turned yellowish and her skin turned a more orangey shade, although the photographic evidence is less than conclusive.



"If this works out, I may be able to breed a super race of orange people who can see better at night than any other living thing."

ARTIST HALL OF FAME

Yourself Experimental Science is flourishing. Presented below are two examples. Be inspired.

THE EXPERIMENT LOG

[http://nuthouse.org/~henderson/college/
experiments/boom.html](http://nuthouse.org/~henderson/college/experiments/boom.html)

"This section looks at the various experiments that several college students (myself included) tried out of simple curiosity and, more often, sheer boredom. You'd be amazed what you can do with duct tape and a gallon of common, household bleach."

Among the home experiments conceived and documented by Andrew Henderson are *Exploding Propane Balloons* (involving a propane-filled balloon, a fishing line from the second floor dorm window and a fire), *Radiation Testing* (microwaving household items to see what happens), and the spectacular *Act of God* ("A flaming mushroom cloud that was a good *five feet* in diameter launched upward from the can, sailing into the ceiling..."). Each experiment is written up in lab-report style, broken into sections *The Situation*, *The Equipment Involved*, *The Plan of Action*, *What Actually Happened* (always different to *The Plan*), and *Lessons Learned*. Under this last category fall pieces of wisdom such as:

"While microwaving metal is pretty entertaining, it's cheaper to buy fire-works than a new microwave."

"Make someone *else* dump the water into the flaming, scalding wax."

"Don't leave anything in a plastic bag on a high shelf in the room you do this in... unless you want it shrink-wrapped."

"Always have a backup propane torch for those occasions when your main torch gets confiscated."

"Launching your socks into orbit is fun, but it really bites when you have to do laundry more often because you don't have enough clothes."

While microwaving a pepper shaker until it turns into a tear-gas bomb might not be everyone's idea of rigorous science, the site is well worth a look.

"You haven't experienced college to the fullest until you've leapt out an open window and rolled around on the ground outside because your clothing was on fire."

(SERIOUS) PHYSICS JOURNAL ARTICLE TITLES

THE SPAWN OF TOO MANY LATE NIGHTS IN THE LAB:

Chicken Plucking as a Measure of Tornado Wind Speed

B Vonnegut 1975 Atmos Sci Res Ctr

Escape from the Menace of the Giant Wormholes

S. Coleman, Physics Letters B, Vol 221 Issues 3-4 1989

Growing Hair on Black Holes

S. Coleman, J. Preskill and F Wilczek 1991 PhRvL

How Bob Laughlin Tamed the Giant Graviton from Taub-NUT space

B A Bernevig, J Brodie, L Susskind & N Toumbas, Journal of High Energy Physics 0102 (2001) 003

Brane New World

S.W. Hawking, T.Hertog & H.S. Reall, Phys Rev D 62 2000

Why There Is Nothing Rather Than Something

S.Coleman 1998 NuPhB

*-Wars Episode I: The Phantom Anomaly

K Intriligator & J Kumar, Nucl. Phys. B620 2002 315-330

*-Trek III: The Search for Ramond-Ramond Couplings

H Liu & J Michelson, Nucl. Phys. B614 2001 330-366

Invasion of the Giant Gravitons from Anti-de Sitter Space

J McGreevy, L Susskind & N Toumbas, Journal of High Energy Physics 0006 (2000) 008

Brane World Inflation Induced by Quantum Effects

[n.b. joke may be unintentional—Ed.]

S Nojiri & S.D. Odintsov, Phys Lett B 484 2000

Research Reveals:

WHY MEN MAKE BETTER ENGINEERS

"The capacity of the penis and testes to move and retract presents the boy with a particular challenge in the development of the body image; this may contribute to his interest in machinery, physics and the like.

"The boy's better spatial sense relates to the greater use he makes of space in motor activity; the ability the boy has to perceive his sexual organ may also contribute to a better representation of space and to his better skill and greater interest in experimental sciences and mathematics."

- from Bertrand Cramer, 'Sex Differences in Early Childhood', in *Child Psychiatry and Human Development*, 1971, 1, 133-51

<<As the 1985 *Journal of Irreproducible Results* points out, presumably Mr Cramer's follow-up study will conclude that women make better speleologists.>>



art & science unite to create ... more shit

The artwork *Cloaca* is a machine that exists to turn food into shit. It is the result of a three-year collaboration between the artist Wim Delvoye and the University of Antwerp, and has been exhibited in galleries around the world. Designed to reproduce the human digestion process as accurately as possible, it is fed a gourmet meal once every day which it digests in a series of six glass vats. It then produces remarkably authentic feces, which—in a kind of delightfully sick pop-art joke—are then packaged, signed and sold for \$1500 apiece.

As a science project, *Cloaca* (named after the ancient sewer of Rome) is quite an impressive feat. Once a day, a chef climbs a stepladder to feed a restaurant-prepared meal into *Cloaca*'s 'mouth', an opening leading to a blending mechanism that chews the food before it begins the 27-

hour-long digestive trajectory.

The six glass vats, connected by tubes,

pipes, pumps and various electronic components, form *Cloaca*'s stomach, pancreas and intestines. The food is kept at constant temperature of 37 degrees Celsius and each of *Cloaca*'s organs contains com-

puter-monitored enzymes, bacteria, acids and bases such as pepsin, pancreatin, and hydrochloric acid.

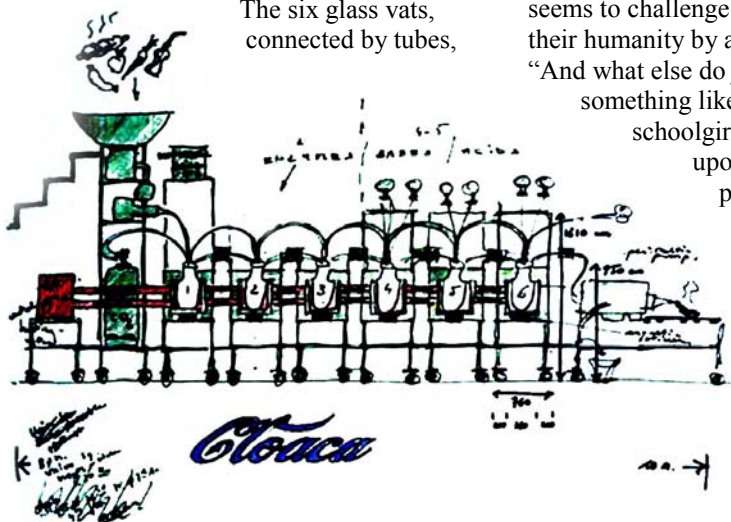
The product finally goes through a separator and the remaining solids are extruded on to a conveyor belt.

As an artwork, the machine is confronting and

unsettling. Perhaps it is the pointlessness of its function; maybe it is something deeper. In a Frankenstein-like manner the machine is intruding on our humanity—a robot that can eat and shit like us seems to have crossed a sacred line. Perhaps it is the confirmation that we exist as purely mechanical, material beings ourselves. The machine, squatting passively in the corner, seems to challenge the visitors to defend their humanity by answering the question, "And what else do *you* do?" Maybe it was something like this that caused a

schoolgirl to burst into tears upon seeing the machine as part of a school excursion. Maybe it was just the smell.

To buy your piece of autographed shit, go to www.cloaca.be



“

One incident stays clearly in my mind. It was 1947, a couple of summers after the war, and I was with my parents in our new Humber touring the South of France. Sitting in the back, I was talking about thallium, rattling on and on and on about it: how it was discovered, along with indium, in the 1860s, by the brilliantly coloured green line in its spectrum; how some of its salts, when dissolved, could form solutions nearly five times as dense as water; how thallium indeed was the platypus of the elements, with paradoxical qualities that had caused uncertainty about its proper placement in the periodic table—soft, heavy and fusible like lead, chemically akin to gallium and indium, but with dark oxides like those of manganese and iron, and colourless sulphates like those of sodium and potassium. Thallium salts, like silver salts, were sensitive to light—one could have a whole photography based on thallium! The thallos ion, I continued, had great similarities to the potassium ion—similarities which were fascinating in the laboratory or factory, but utterly deadly to the organism, for, biologically almost indistinguishable from potassium, thallium would slip into all the roles and pathways of potassium, and sabotage the now-helpless organism from within. As I babbled on, gaily, narcissistically, blindly, I did not notice that my parents, in the front seat, had fallen completely silent, their faces bored, tight, and disapproving—until, after twenty minutes, they could bear it no longer, and my father burst out violently: **“Enough about thallium!”**

”

—*Oliver Sacks: neurologist,
professor, author, nerd.*

- CUT OUT, FOLD, AND ASSEMBLE AS ILLUSTRATED.
- VIEW FROM 2'...
CLOSE ONE EYE
LOOK INTO THE
EYES OF THE
CREATURE
AND ROCK
BACK AND
FORTH. WOW!

MOUNTAIN FOLD

VALLEY FOLD
TO WHITE DOT

MOUNTAIN FOLD

VALLEY FOLD

MOUNTAIN FOLD

VALLEY FOLD

FOLD TO HERE

MOUNTAIN FOLD

TAB E
TAPE TAB E
BEHIND HERE

TAB D
TAPE TAB D
BEHIND HERE

TAB C
TAB B
TAB A
BEHIND HERE

VALLEY FOLD

VALLEY FOLD

CUT TO WHITE DOT

TAB A

FOLD TO HERE

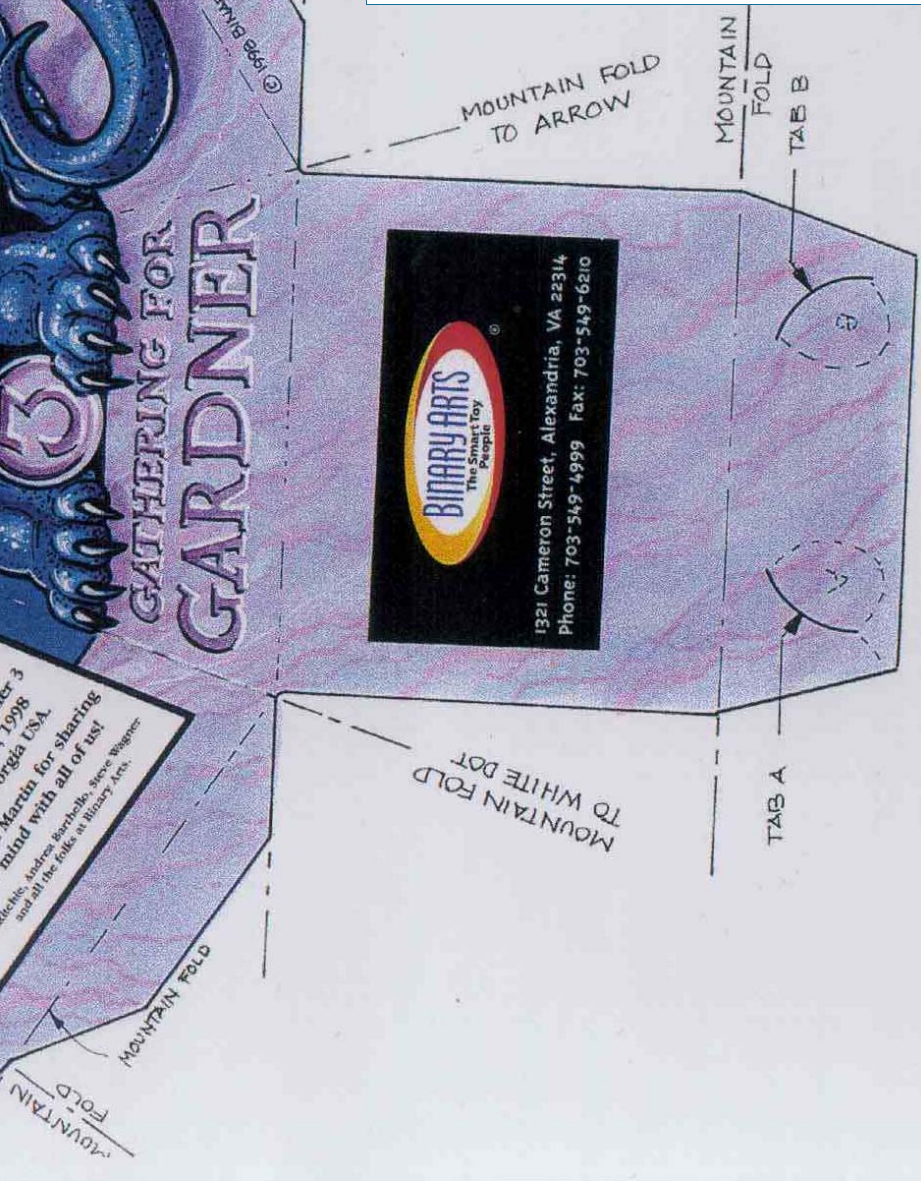
This desk top creature was inspired by the work of Jerry Andrus to celebrate Gathering for Gardner Atlanta, Georgia January 16-18 Thank you your Bill

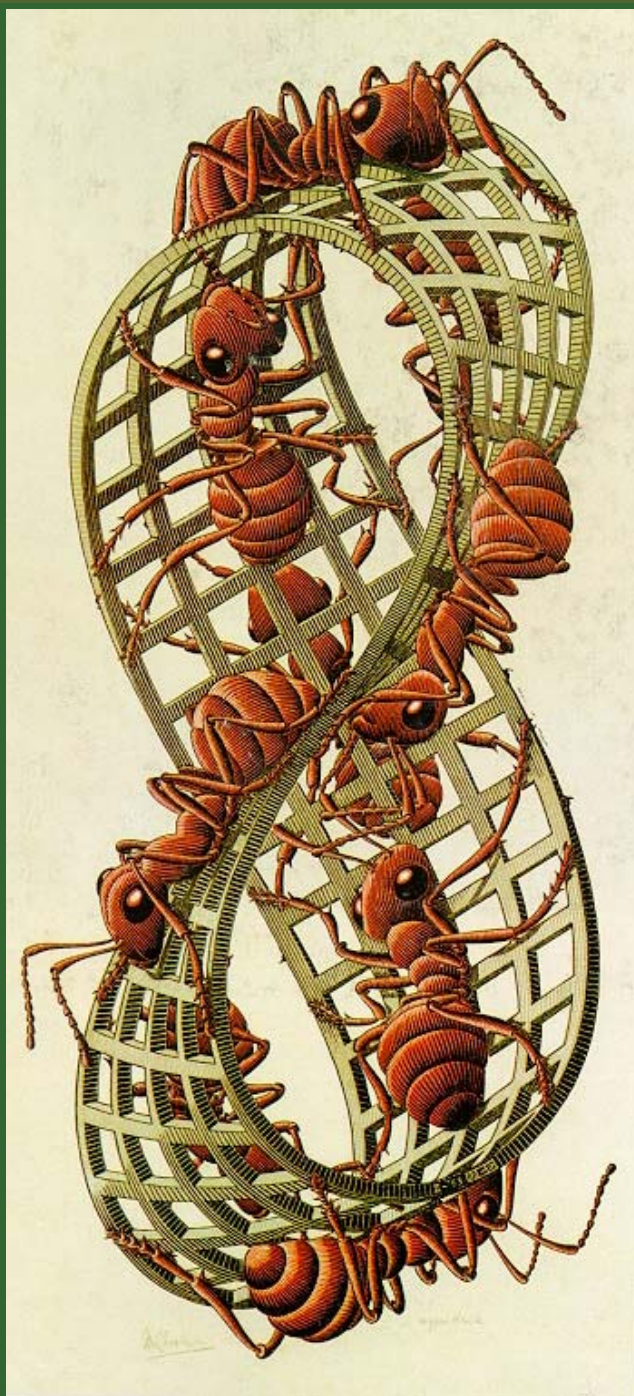
TAB D

STARTLING AND WONDERFUL OPTICAL ILLUSION

Photocopy the page, cut out the dragon and follow the assembly instructions. Then put the dragon on a shelf at eye-height, close one eye, convince your mind that the dragon's head is convex instead of concave, and move back and forth in front of the dragon.

ITS HEAD WILL SPOOKILY TURN TO FOLLOW YOU AROUND THE ROOM.
Image and instructions from www.grand-illusions.com/dragon.htm





THE MÖBIUS STRIP

A Möbius Strip is a surface which has only one side and one edge. This gives it some bizarre characteristics that have seen it turn up in places from magicians' shows to sci-fi stories as well as serious mathematical literature. The best way to get to know just how weird it can be is to make your own model, and we've included a Möbius kit right here on this page. Just cut the shaded strip off the edge of this page, give one end a 180-degree twist, and then join the two ends with tape or glue.

The Party Trick.

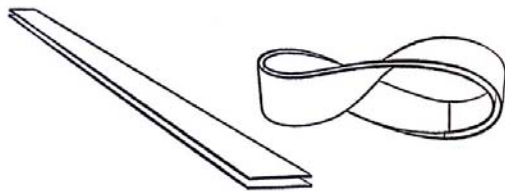
Take the Möbius Strip you've just made from the right-hand side of this page and put your finger on the diagram that appears on it. Trace along the centre line until your finger again touches the diagram. You will notice something quite interesting: your finger has to make *two* turns of the loop before you return to your starting point. To put it another way, you can trace both the front *and* the back of the strip without crossing an edge. This property was illustrated in Escher's print, shown opposite, in which the path of an ant along a Möbius Strip is shown to cover the entire surface.

Now cut completely along the central dotted line. What happens to the strip? Not what you might expect! (Can you reassemble it?) Now make another strip the same as the first, but this time give the end a full, 360 degree twist before joining it to the other. What happens when you cut down the centre strip this time? Another surprise! Curiouser and curiouser.

For experienced Möbius users who are already familiar with the above examples, here's something you might not have seen before: take a new Möbius strip and cut it lengthways, but this time instead of cutting down the centre, make the cut lie one-third of the distance from one edge and see what happens.

Now make a double band as shown below. If you run your finger between the two resulting layers, will it stay between the strips or emerge on the outside? Are there two separate pieces or only one? If you take it apart without breaking the joins, will you be able to put it together again?

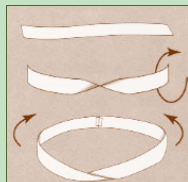
These strange properties of Möbius Strips have seen them used in magicians' shows for over one hundred years in order to befuddle, astonish and mystify their audiences.



Double Möbius band is made by placing two strips of paper together (left), giving both of them a half-twist and joining their ends as indicated at right.

Image from Martin Gardner's *Mathematical Puzzles and Diversions*

Möbius strip kit: cut along the **solid** line. Twist the strip one half-turn and glue or tape the ends together. You now have a Möbius strip. Cut along the entire length of the **dashed** line and see what happens!



A mathematician confided
That a Möbius band is one-sided,
And you'll get quite a laugh
If you cut one in half
For it stays in one piece when divided.

The History.

The Möbius Strip was invented by a German mathematician named Johann Benedict Listing, who first encountered the surface in July 1858 and published his discovery in 1861. August Ferdinand Möbius independently came across the strip two months after Listing but didn't publish until 1865. It is somewhat ironic that Möbius should receive all the credit, because he had a lack of self-assertiveness that saw him hold relatively minor professional positions.

Möbius, who was an astronomer and mathematician at the University of Leipzig, was interested in the Möbius Strip for the broadly the same reason as Listing: because of its involvement with the geometrical theory of polyhedra. Generally, in solids enclosed by plane faces, the number of vertices (V) minus the number of edges (E) plus the number of faces (F) equals 2, or $V - E + F = 2$. This is known as Euler's Theorem. A cube, for example, has 8 vertices, 12 edges, and 6 faces: $8 - 12 + 6 = 2$. However, the formula doesn't work for all polyhedra. For example, a polyhedron that looks like a squared-off doughnut with a square hole in the middle has 16 vertices, 32 edges, and 16 faces, so $V - E + F = 0$. Another exception, as Möbius realised, was the Möbius Strip. If it were considered to be a strip of flat triangles, for instance, the strip can be twisted and joined at its ends to form a one-sided surface (and zero-volume polyhedron) which violates Euler's Theorem.

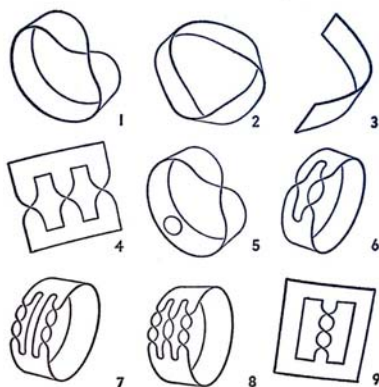
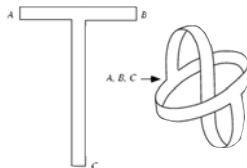
Möbius is also notable for introducing the notion of orientability, which allowed him to put a minus sign in front of lengths, areas, and volumes. The notion of the dual polyhedron is also due to Möbius. (See **nerdling #5** p27 for a description of duality.)

Brothers and Sisters of the Strip.

There are many Möbius-like objects which have only one side and one edge. One, shown at right, is fetchingly known as 'Möbius Shorts'.

Martin Gardner documents other Möbius-like objects, shown below, in his book *Mathematical Puzzles and Diversions*. Objects 1 and 2 have one side and one edge only; 3 and 4 have one edge but two sides; and the others are one-sided and two-edged.

It is easy to construct most of these objects out of paper. Just as with the regular Möbius strip, cutting them yields interesting results. For example, cutting surface 2 in half will yield a large band with a knot in it.



The three-dimensional equivalent of the Möbius Strip is the Klein Bottle. It is a surface with no edges and only one surface. If you cut a Klein Bottle in two (as shown below), it becomes two mirror-imaged Möbius Strips.

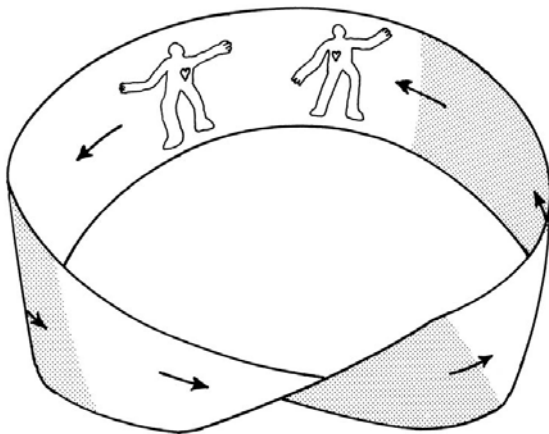


The Real-Life Space Warp.

Imagine a simplified drawing of a woman, made on transparent paper. The left and right sides of the sketch are differentiated by placing the heart on the character's left-hand side, as is the case in real life. Now imagine that this two-dimensional figure comes alive like an animated character, and is able to walk around on the page.

There is no way her heart can change sides unless she is plucked off the paper into the third dimension, flipped over, and placed back on the sheet as shown in the figure below (from Michio Kaku's *Hyperspace*).

However, if the transparent surface on which our 'flatlander' lives is twisted into a Möbius Strip, something interesting happens. If she makes one lap of the strip, as in Figure 2, she will find that her heart is now on the other side! Her entire body has been flipped, as in a mirror—something otherwise impossible without leaving the surface.

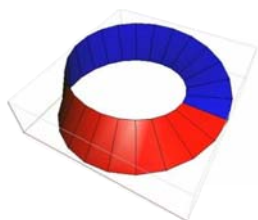


Many people have speculated about extrapolating this situation into the fourth dimension. If our universe had a 'twist' in it, like a four-dimensional Möbius Strip, we would be no more aware of it than our flatlander—unless, of course, we were able to circumnavigate the universe, when we would find upon our return that our hair is parted on the other side and our lungs are on the left!

In "The Plattner Story" by H. G. Wells, science teacher Gottfried Plattner is performing a chemistry experiment when it blows up. The explosion sends him into another universe. When he returns, doctors are stunned to find that his organs have reversed their usual sides, which "is proof that he has moved out of our space into what is called the Fourth Dimension, and that he has returned again to our world." The same effect could be achieved, *sans* explosion, by simply walking around a hyperspatial Möbius Strip.

Modelling the Strip in 3D.

The following parameterisation (from http://sweb.cz/dp_dp_2/mts-gal.htm) will enable you to model the Möbius strip using software such as *Mathematica* or *Pov-Ray*. The latter program has been used by **nerdling** to produce the pair of 'magic-eye' images shown to the right. If you relax your eyes and focus just behind the page so that the two images overlap, you will be able to see the strip in 3D.



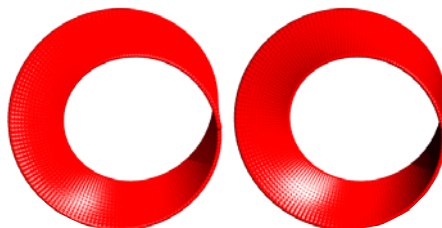
Moebius strip

$$z = \cos(u) + v \cos(0.5u) \cos(u)$$

$$y = \sin(u) + v \cos(0.5u) \sin(u)$$

$$z = v \sin(0.5u)$$

$$u \in (0, 2\pi), v \in (-0.3, 0.3)$$



Practical Uses of the Möbius Strip.

Since its discovery in the 19th century, the strip has achieved a life of its own beyond mathematics—in magic, science, engineering, literature, music, and art, and in the form of the ubiquitous symbol for recycling.

In engineering, for example, Lee De Forest obtained a 1923 U.S. patent for a Möbius film-strip that records sound on both "sides." The same idea was later applied to tape recorders so that a twisted tape would run twice as long as it would otherwise. Several patents have also been granted for Möbius strip conveyor belts designed to wear equally on both sides.

The Möbius strip shows up in all sorts of unexpected settings, from sculptures, synthetic molecules, and postage stamps to knitting patterns and skiing acrobatics.



Möbius chair by Petra Rothbauer; Möbius sculpture in Japan; and Möbius stamp.



The Möbius Strip in Design: The Recycling Sign

The standard recycling symbol (top left) and an alternative version (top right) can be represented by continuous folded ribbons, showing that the standard form is a Möbius band made with one half-twist (bottom left) and the alternative is a one-sided band with three half-twists (bottom right).

The emblem started with a contest sponsored by the Container Corporation of America as a special event for Earth Day in 1970. Art and design students were invited to create a symbol to represent paper recycling. The winning logo, selected from more than 500 entries, was submitted by Gary Anderson, then an art student at the University of Southern California.

"The figure was designed as a Möbius strip to symbolize continuity within a finite entity," Anderson recounted in a 1999 interview. "I wanted to suggest both the dynamic (things are changing) and the static (it's a static equilibrium, a permanent kind of thing)." Anderson's original design was then refined by Bill Lloyd, CCA's public relations department manager. He sharpened the lines and rotated the symbol so that the stylised outline of a tree can be seen in its centre.



Standard Symbol



Alternative Symbol



Möbius Band



Alternative Band

MATH AND MUJAHEDDEEN

1

I feel that Math is the universal language [...] Math unlike literature doesn't evoke emotions, but is a useful general tool for solving problems. As long as people push and challenge themselves as well as others to be inventive for the greater [good] of mankind, may the world grow together.

- Norman Blakley West II, *Forum on Mathematics and the Nobel Prizes* [http://almaz.com/nobel/why_no_math.html]

Mathematics, like any other discipline, lends itself to building several paths towards education for peace.

- from *"The mathematics of war"*, Michele Emmer, Rome

For many of us who have made careers as scientists, doing science is not simply a matter of earning a living. I often like to think of science in terms of its "usefulness" -- as a way to figure out things I didn't already know. And I always enjoy hearing about the clever way a colleague has found to apply scientific reasoning to questions that arise in everyday life.

- Ralph Kahn, *PUMAS (Practical Uses of Maths And Science) Editor and Founder* [<http://pumas.jpl.nasa.gov/>]

2

EXERCISE 1

You are part of a group of mujahedeen in Manama, Bahrain, and you learn that a U.S. official goes to the embassy every morning at 7:35. If, with Allah's help, you manage to reach him, you will assassinate him; otherwise you will return as if nothing happened. Two men from your group take their weapons and set off at 7:20 from the black circle on the enclosed map. It was, however, Allah's will that they reached the embassy at around 7:36, and the U.S. official had already passed. Now, you are the knowledgeable person in the group, and you tell yourself that the men should have hurried a bit more. The question is: what was the approximate speed of the men?

Answer: Speed is represented by the equation $\text{speed} = \text{distance} / \text{time}$. Now, before we make the calculation, we must convert our units: minutes to hours, and centimeters on the map to kilometers on the ground. So we end up with distance of 18 kilometers and time of 0.266 hours. Our equation leads to a speed of 67 kilometers per hour, meaning the men should have picked up the pace to about 75. Is that understood, guys? Whoever doesn't get it can ask—there's no shame in that.

—from Kuttab-al-Battar, a manual posted in April on jihadist websites. It was translated by the SITE Institute, Washington, and appeared in *Harper's Magazine*, July 2005

An introduction to 'INTRODUCTION TO PHILOSOPHY'



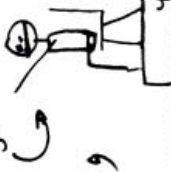
The cast:

the good lecturer



the boring, condescending lecturer.

the mature-age student



single dork with laptop



this is you



Good luck!



the confused christian



the argumentative schoolboy who thinks he's really great



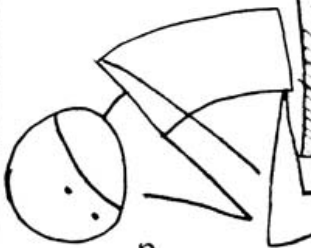
LESSON #1

No, there will be no multiple choice questions in the exam.

Which is it better to

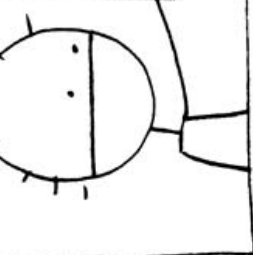
#2

Although "the thinker" is in your textbook, he is not Descartes. He is Dante thinking about a play.



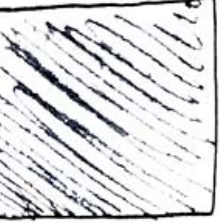
ok like him at the course you pass

or:
A. Socrates
dissatisfied
B. A happy pig
(tick one)



Hell, flames,
people, torture.
Not pissy epic-
phenomenalism
and what-not.

* But if you lo



#3

Any discussion
involving modern
science will be a tortuous
mix of ignorance and
poorly understood clichés.

Quantum mechanics
tells us everything
happens at random
times

Didn't Einstein
say time doesn't
exist?

may
be.



#4

Some theories
are nowadays
quite clearly bullshit
but out of respect for
the dead we have to keep
learning them. Bonus

You pretend
marks if
you think
they are
super-
great.



R.I.P.

"I made up
Occasionalist
Dualism and
I am very
important"

*also You won't go to hell.

Other tips:

★ Always pretend
You're a vegetarian
in essays

◎ Lie when writing
the word-count on
the cover sheets to
your essays. They
will never check.

✿ Passing this course
won't make you
smarter.

! Remember, most of the
gaping holes you find in
various arguments are
due to Sucky lecture notes
and not Aquinas etc.

beware: continued next issue.

GLORIOUS PROGRESS THROUGH SCIENCE

January–April 2005

JANUARY

Scientific research brought us the knowledge that gecko feet are self-cleaning, that organic ketchup fights cancer better than the regular kind, that drinking green tea turns mice into better swimmers, and that Saturn's moon Titan has liquid-methane rain and a crust with the texture of crème brulee.

Sir David King, the Chief Scientific Advisor to the United Kingdom, was under attack by American lobbyists for saying that global warming is a problem. Days later, snow fell in the United Arab Emirates. Elsewhere, experts theorized that the Great Dying of 250 million years ago—the most extensive mass extinction in history—was caused by global warming due to volcanic activity.

American preschoolers were more obese than ever. Scientific studies found that commercial diet programs don't work very well, and that fidgety people are less likely to be obese.

The World Health Organization warned that the bird flu virus endemic in Asia was mutating in such a way that it could cause a major, over-

due human influenza outbreak with a "best case scenario" of 2 million to 7 million deaths.

Astronauts aboard the international space station reported they'd had little to eat except candy for the last five weeks. Bill Gates announced the arrival of the digital lifestyle; then his computer crashed. The U.S. Army was planning to deploy knee-high robots equipped with machine guns to fight Iraqi insurgents.

British scientists announced that they had developed a printer capable of producing human skin to supplant traditional skin grafts. Scientists synthesized a pheromone produced by young women that helps post-menopausal ladies attract men; and fertility treatment allowed a 67-year old Romanian woman to fall pregnant with twins.

Lawrence Summers, the president of Harvard, spent the week apologizing for publicly musing that women were innately less capable at science and math than men. Religious leaders blamed God for the tsunami. George W. Bush was sworn in again as U.S. president.

FEBRUARY

Scientific studies determined that sunlight helps fight cancer, that barbecues cause cancer, and that overweight people have a stronger biological need to sit than others do. Other research established that rats are responsible beer drinkers, chimpanzees have a sense of justice, and that birds are not dumb.

Scientists at the U.S. Fish and Wildlife Service told of being forced to cover up their findings regarding risks to endangered species. Forty-two percent said they feared retaliation if they told the truth.

A study showed that 310,000 Europeans die from air pollution each year, and NASA found that 2004 was the fourth-warmest year ever recorded. The Kyoto Protocol, which calls for a 5.2 percent reduction in greenhouse gas emissions by 2012, was ratified by 155 countries and went into effect; neither Australia nor the world's top polluter, the United States, signed, citing costs. Congress was once more casting its eye towards the oil in Alaska's Arctic National Wildlife Refuge.

Scientists were waiting for H5N1, an avian flu virus that has killed forty-one people in Thailand and Vietnam, to mutate into a form that can spread more rapidly among humans. If that happens, the flu is expected to kill tens of millions worldwide. Thailand rejected a plan to slow the spread of the flu because the plan's execution—which called for the destruction of millions of possibly infected ducks and chickens and the distribution of face masks—would alarm the public.

NASA scientists resurrected bacteria that had been frozen for 32,000 years. Canadian scientists announced

that they could treat depression by electronically stimulating the brain. Frozen urine dropped from the sky in Scotland. The creator of Dolly the sheep was granted a license to clone humans. NASA researchers studying the methane signatures of Mars found evidence of life below the Martian surface, and the decision was made to scrap the Hubble space telescope. Chinese scientists announced the development of a new process that turns sewage water and mud into organic fertilizer and pesticide.

It was discovered that the United States has been sending unmanned drones to spy on Iran's nuclear facilities since April 2004. United States immigration authorities were evaluating a program that uses unmanned drones to patrol the border of Arizona and Mexico, and Israel unveiled a tiny new drone that can be launched from a canister.

The Pentagon allocated \$127 billion to build a robot army. Some of the robots will look and walk like humans, some will hover in the air, and some will make their own choices during battle. "The lawyers tell me there are no prohibitions against robots making life-or-death decisions," said a representative from the U.S. Joint Forces Research Centre.

Israel developed a bomb that stinks for five years, thirty kilograms of plutonium in an English nuclear power plant were unaccounted for, and Russia agreed to sell nuclear fuel to Iran.

Evolution was not being taught in many U.S. high schools.

Secret documents showed that Cambridge University, among other institutions, neglected and tortured monkeys in its laboratories.

MARCH

U.S. scientists were working on a device that shoots pain rays up to two kilometres. A group of researchers at Stanford University were preparing to use stem cells from aborted fetuses to create a mouse that has human brain cells, and Russian doctors grew a penis on a man's arm.

Scientific studies revealed that a man's boisterousness is a reflection of whether his index finger is short when compared to his ring finger; that soap and water are effective in cleaning your hands; and that the stealing habits of rhesus monkeys are similar to those of humans.

Florida lawmakers were considering an Academic Freedom Bill of Rights, intended to stamp out "leftist totalitarianism," that would allow students to sue teachers who insist that evolution is factual. Several IMAX theatres in the American South decided not to show a film about volcanoes because it might offend Christians.

Archaeologists in Ethiopia unearthed several four-million-year-old skeletons believed to be ancestors of modern humans. Scientists found that some species of octopus can walk on two arms, and two planets, HD 209458b and TrES-1, were discovered near different stars.

Global warming was melting the glaciers in the Himalayas, and a snow festival in Arctic Greenland was cancelled due to a heat wave. The U.S. Senate passed a resolution that will permit drilling for oil in Alaska's Arctic National Wildlife Refuge. Pollution has killed all but thirteen river dolphins in China's Yangtze River, and the U.S. Navy was looking into whether sonar

confuses dolphins, causing them to surface too quickly and get the bends.

There was an outbreak of avian flu in North Korea. Studies showed that thousands might die of the avian flu in New Zealand. Other research showed that African-American men die at nearly twice the rate of white men of a similar age.

A New York judge dismissed a lawsuit brought against Monsanto, Dow Chemical, and several other chemical companies on behalf of 4 million Vietnamese who were poisoned by the 80 million litres of Agent Orange sprayed during the Vietnam War. The judge said that there was no clear link between Agent Orange and the illnesses of the Vietnamese plaintiffs.

Microsoft was developing a teddy bear with a rotating head that will watch little children, and Bill Gates was knighted. Three anonymous donors gave \$3 million to resurrect the cancelled TV show "Star Trek: Enterprise," a very rich man flew solo around the world in sixty-seven hours, and humans could still beat robots at arm wrestling.

The Israeli army denied high-level security clearance to soldiers who play Dungeons & Dragons.

APRIL

A scientist catalogued 395 different species of bacteria in the lower intestines of three healthy humans, and entomologists named three newly discovered species of slime-mould beetle after George W. Bush, Dick Cheney, and Donald Rumsfeld.

After four years of hard work, 1,300 researchers in ninety-five countries concluded that humans are destroying the world.

It was revealed that U.S. Interior Department scientists studying the environmental effects of a proposed nuclear waste dump at Yucca Mountain, Nevada, had made things up and deleted findings they did not understand so that the development of the dump could go forward. "Science by peer pressure is dangerous but sometimes it is necessary," one scientist wrote in an email.

Samples of the deadly Asian flu were accidentally mailed out to 3,700 labs worldwide. Several samples were missing.

Scientists in California weighed a cluster of xenon atoms and measured them at a few zeptograms. A new species of titi monkey was discovered in Bolivia and will be named the Golden-Palace.com monkey. Researchers found that parents tend to take better care of their better-looking children. Olga, the first Siberian tiger ever fitted with a radio collar, was killed by poachers.

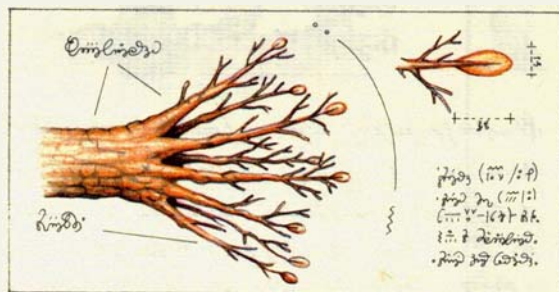
Britain stopped importing United States corn after discovering that the United States had been sending banned, genetically modified corn to the U.K. for the past four years. Brewer Anheuser-Busch, America's number one buyer of rice, announced that it will no

longer buy rice from Missouri if that state allows genetically modified rice to be grown within its borders.

One hundred thirty-seven million people were overweight in China, and America's 7 million vending machines were being visited by 100 million people a day. It was announced that Cookie Monster would cut back on cookies.

A handicapped man used a computer chip implanted in his brain to control a television, geneticists bred blue roses, scientists at Yale University used lasers to control headless fruit flies, and a Danish study found no link between cell phones and brain tumours. Scientists drilled 4,644 feet into the earth's crust, nearly reaching the mantle; and infrared technology was used to read lost works by Sophocles, Euripides, and Hesiod. Archaeologists in Germany uncovered a 7,200-year-old pornographic statue.

Pakistan successfully test-fired the Hatf II, a short-range nuclear-capable missile. The U.S. Army's Psychological Operations group was developing propaganda science fiction comic books for distribution in the Middle East.



*Culled from Harper's Magazine Weekly Reviews, January—April 2005
Illustration from the Codex Seraphinianus*



sweet, sweet nerdism

nerdling.zine@gmail.com

www.nerdling.net